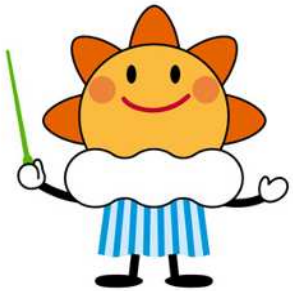
TCC Training Seminar on Global Warming Projection Information
14:00 – 14:45 on 27 January 2015

How to make global warming projection for your country

Koji Ishihara



Today's schedule

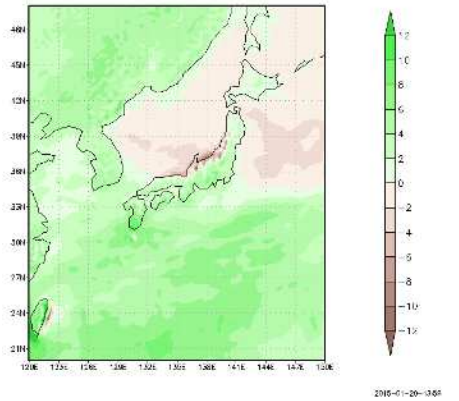
14:00 – 14:45
Lecture: How to make global warming projection for your country

14:45 – 15:45
Lecture and exercise: Check of reproducibility

16:00 – 17:00
Lecture and exercise: Assessment of future climate change

17:00 – 18:00
Lecture and exercise: Uncertainty check of the results

Let's make global warming projection information for Japan, as confirming the necessity of each work !

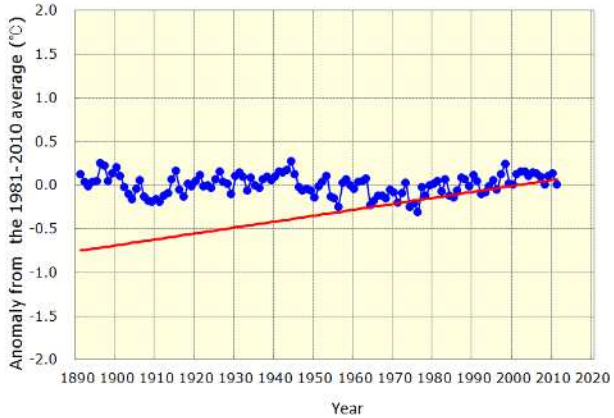


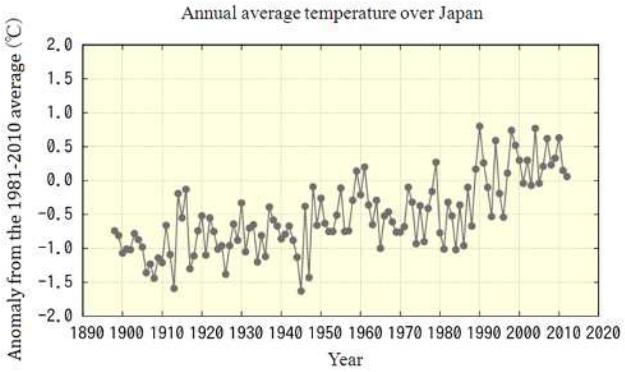
Introductory remarks on interpretation of climate projection and key uncertainties

The aim is to project climate change signals rather than natural climate variability.

Even state-of-the-art climate models cannot predict natural variability.

The 20-year average of results from the climate model are used for global warming projection.



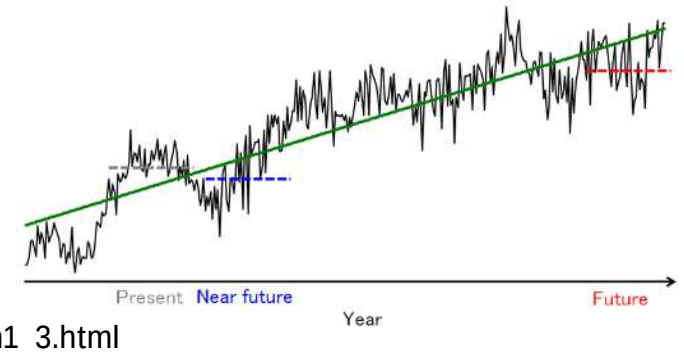


Uncertainties in regional-scale climate projections are greater than those in global-scale climate projections.

It is necessary to examine whether projected regional-scale climate change is consistent with broader-scale climate change.

Uncertainties in near-future climate projections are larger than those in future climate projections.

As the level of greenhouse gas concentration in near-future projections is expected to be lower than that in future projections, less pronounced climate change signals may be dominated by natural variability.

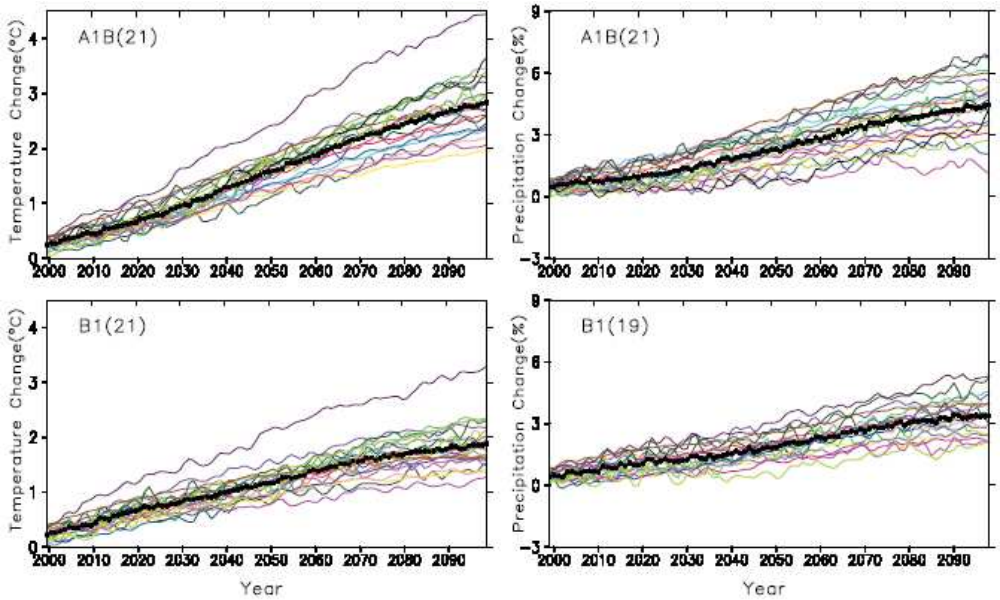


http://ds.data.jma.go.jp/tcc/tcc/products/gwp/gwp8/html/section1_3.html

Introductory remarks on interpretation of climate projection and key uncertainties

Uncertainties exist even in long-term trends.

Future climate projection uncertainties can be estimated via multi-model or multi-parameter experiments.



The ability of models to project future climate conditions is limited.

Large-scale patterns averaged over a broader area provide a more meaningful picture than changes on a single-grid scale.

Uncertainties in future projections depend on the variables used.

Detecting climatological trends for precipitation is more difficult than that for temperature because extreme rainfall events are rare by definition and occur on relatively limited spatial and temporal scales.

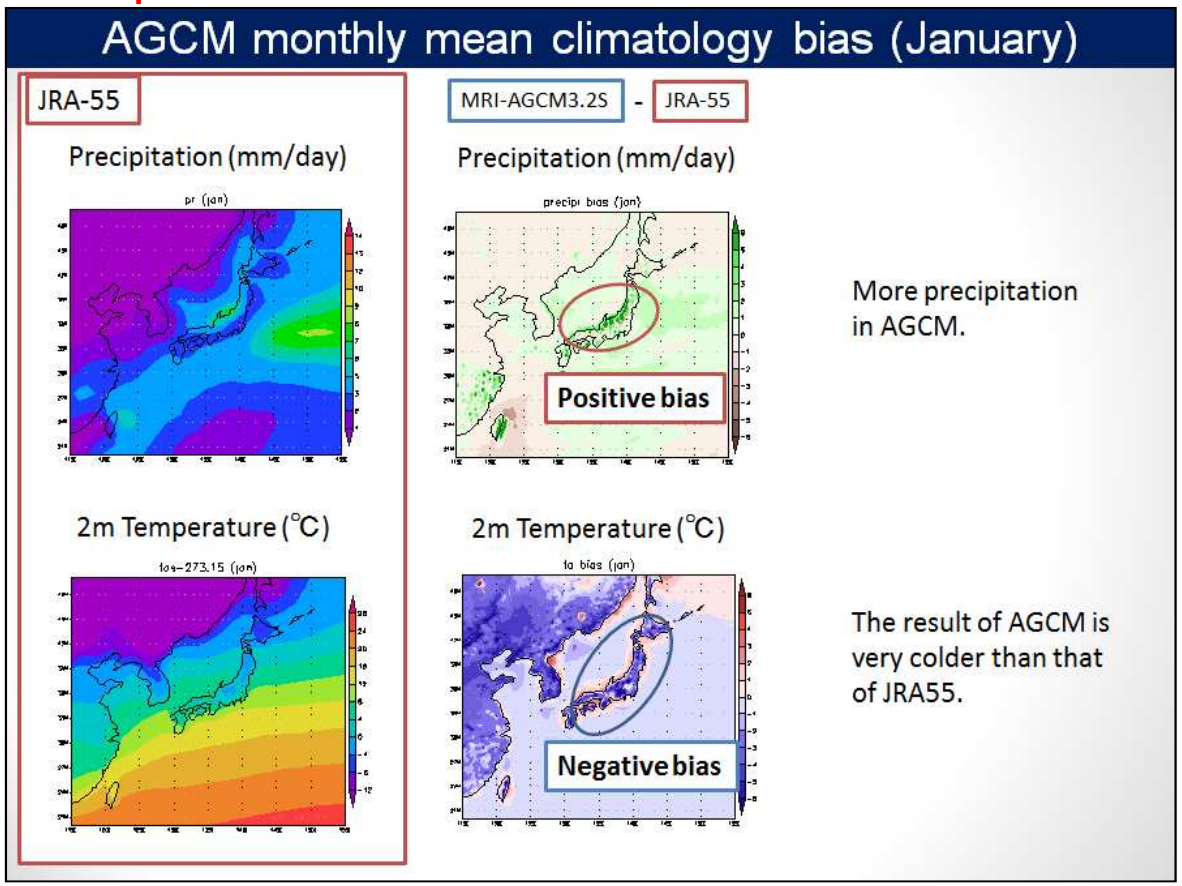
Future projections depend on the greenhouse gas emissions scenario used.

http://ds.data.jma.go.jp/tcc/tcc/products/gwp/gwp8/html/section1_3.html

Step 1 : Check of reproducibility

- Every model has its own bias resulted from physics, parameterizations and so on.
- The reproducibility is judged by calculating the bias defined as “Simulation minus JRA-55”.
- If the bias over your country is very large, the projected results should be treated more carefully.
- Bias correction is the way to overcome the problem, which adjusts present simulation to observation.

Sample



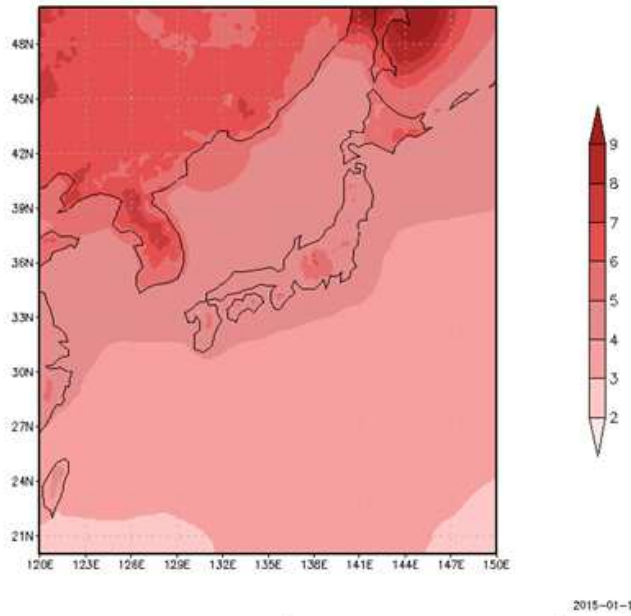
Step 2 : Assessment of future climate change

- Compare “future climate (2079-2099)” with “present climate(1979-2003)”

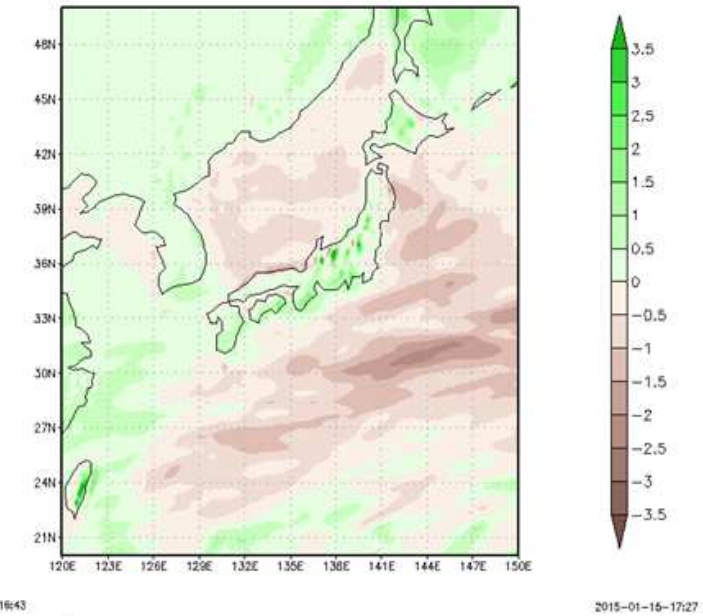
Sample

Future climate change (January)

change in surface air temperature



change in precipitation



- ✓ Temperature around Japan is projected to increase between 3 to 5 deg C.
- ✓ The region at high latitude will warm more rapidly.

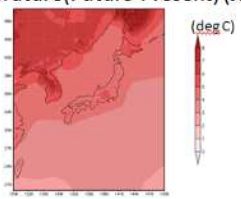
- ✓ Precipitation on land of Japan is projected to increase in the future.

Step 3 : Uncertainty check of the results

Sample

Check of uncertainty（Temperature in January）

Temperature(Future-Present) (Jan)



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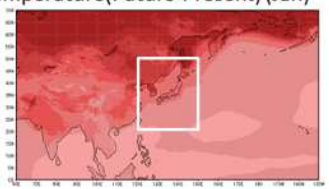
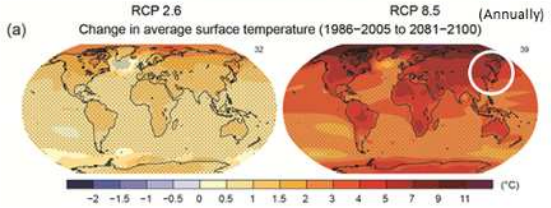
Temperature(Future-Present) (Jan)



- Wide area change (right top)
  - These two features are similar.
  - In addition, land area will warm more than ocean.
  - Therefor, uncertainty of area is small.
- AR5 by multi model (right bottom)
  - These features are consistent.
  - So, uncertainty of single model is small.
- Model bias
  - Pressure gradient of winter is reproduced.
  - Negative bias is offset.
- Therefore, it is considered that the two features show future climate change.

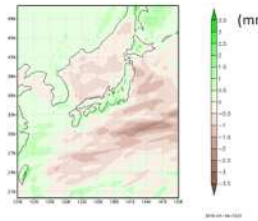


Uncertainly

- Natural climate variability
- Regional scale
- Incompleteness of climate model
- Short period for calculation

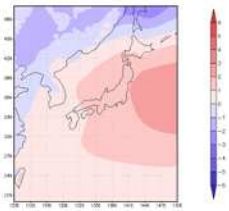
Check of uncertainty（Precipitation in Ja

Precipitation (Future-Present) (January)



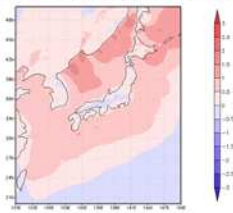
- ✓ Precipitation on land of Jap… projected to increase in the future.

Sea Level Pressure (F-P) (hPa)



- Synoptic scale
  - Sea level pressure gradient weakens in future (right top), and surface meridian velocity strengthens in future (right bottom).
  - These indicate that moisture supply decrease to atmosphere at Sea of Japan (A). This is different from the prediction results (left top).
- Surface temperature
  - On the other hand, increasing surface temperature suggest that precipitation increases since saturated vapor pressure increases (B). This is consistent with the prediction results.
- Model bias
  - Jet stream is located more equatorward ,which means cold air from Siberia is stronger.
  - This strengthen effect of (B) than (A), and might increase precipitation.
- Therefore, it is difficult to consider that the feature show future climate change.

Surface Meridian Velocity (F-P) (m/s)



Let’s try these exercises!